COMPOSITE BASE PLATE FOR A DISC DRIVE HAVING AN INTEGRAL PRINTED CIRCUIT BOARD

Field of the Invention

This application relates generally to data storage devices and more particularly to a data storage device having a composite base plate incorporating a printed circuit board.

Background of the Invention

Current disc drives store information on rotating discs that are typically either optical or magnetic. Magnetic discs are coated with a magnetizable medium on which data is recorded. The recorded information is arranged typically on concentric tracks around the axis of rotation of the discs. One or more transducers, commonly referred to as "heads", are movably positioned over the disc surfaces to read and write data from and to the rotating discs. The heads are mounted on an actuator that positions the heads over and moves them from one track to another on the disc. The sheer volume of magnetic disc drive production is increasing every year. In addition, the data density on each of the disc surfaces is being increased every year that require drive designs to be easily manufacturable. The size, or "form factor", of each generation of disc drives is continually getting smaller. The smallest drive currently in the market is a one-inch drive, which is in the form factor of a CF card (Compact Flash, type II). The type II CF form factor requires an overall thickness of no more than 5.5mm. However, there is a continuing need to reduce the size of the drive even smaller without sacrificing capacity and performance.

An exploded view of the primary components of a base plate and printed circuit board assembly **100** for a conventional one-inch disc drive is shown in FIG. **1**. A cross sectional view of the assembly **100** is shown in FIG. **2**. The assembly **100** includes a base plate **102** to which various components of the disc drive will be subsequently mounted. Fastened to the bottom of the base plate **102** is a printed circuit board assembly **104**. Finally, fastened to the bottom of the printed circuit board (PCB) assembly **104** is a printed circuit board (PCB) shield **106**. These three components, the base plate **102**, the PCB assembly **104**, and the PCB shield **106**, are mechanically assembled together in a conventional manner as is shown in the cross sectional

view of FIG. **2**. Here it can be seen that the PCB assembly **104** is spaced from both the PCB shield **106** and the base plate **102** by gaps **108** and **110**. The drive motor coils **114** are installed in the base plate **102** before the PCB assembly **104** is installed on the base plate **102**, thus requiring a drive motor connector having pins **116** to be present to contact with pads on the PCB assembly **104** when the PCB assembly **104** is joined with the base plate **102**. This current base plate **102**, at its thinnest, is about 0.5 mm thick. Reducing this thickness further leads to very severe structural instabilities.

One current challenge is to design a disc drive in a CF type I size. Such a drive has an overall thickness requirement of only 3.3 mm. There are no disc drives available that have a 3.3 mm thickness. A drive having a design thickness of only 3.3 mm has a number of problems. The base plate upon which the actuator and disc spin motor both are mounted becomes so thin as to be unacceptably structurally weakened. Thus a new concept of a base plate is needed that is both thin enough and strong enough to adequately support the moving components within the disc drive yet and, at the same time, permit a maximum thickness of the drive to be limited to 3.3 mm total form factor. The present invention provides a solution to this and other problems, and offers other advantages over the prior art.

Summary of the Invention

Against this backdrop the present invention has been developed. An embodiment of a support structure for a data storage device such as a miniature disc drive in accordance with the present invention includes a base plate for supporting a drive motor and an actuator assembly, to which is fastened a printed circuit board via a layer of adhesive filling a gap between the board and the base plate. This layer is preferably an epoxy adhesive that together with the board and base plate forms a composite integral support structure. The disc drive may also have a shield plate spaced from the printed circuit board by a gap. However, in the present invention, this gap is in turn also filled with an epoxy adhesive layer to form a cohesive drive motor and actuator support structure that provides further stiffness to the composite structure. The printed circuit board components may project into apertures in the base plate so as to minimize the overall thickness of the composite structure.

These and various other features as well as advantages which characterize the present invention will be apparent from a reading of the following detailed description and a review of the associated drawings.

Brief Description of the Drawings

FIG. **1** is an exploded perspective view of the base plate and printed circuit board structure for a conventional one-inch disc drive.

FIG. **2** is a partial cross sectional view of an assembled base plate and printed circuit board assembly for a conventional one-inch disc drive.

FIG. **3** is a partial cross sectional view of an embodiment of an integrated composite base plate and printed circuit board structure for a disc drive in accordance with an embodiment of the present invention.

FIG. **4** is a partial cross sectional view of an alternative embodiment of an integrated base plate and printed circuit board structure for a disc drive constructed in accordance the present invention.

FIG. **5** is a process flow diagram for the manufacturing sequence of operations in constructing an integrated base plate and printed circuit board structure for a disc drive of the embodiment shown in FIG. **3**.

Detailed Description

Referring now to FIG. **3**, a first embodiment of an integrated base plate and printed circuit board structure **200** in accordance with the present invention is shown in partial cross section. The composite structure **200** includes a base plate **202** similar in configuration to the base plate **102** shown in FIGS. **1** and **2**, except that, at its thinnest, it is preferably between about 0.2 mm and 0.3 mm in thickness. Fastened to the base plate **202** is a printed circuit board assembly **204** that includes a connector **205**. A gap **208** between these two components is filled with epoxy adhesive **210**, which, when cured, bonds the base plate **202,** the PCB together with the connector **205** in the PCB assembly **204,** together to form an integrated, stiff disc drive base structure **200.** The base plate **202** has one or more apertures **220** therethrough that are positioned to receive portions of integrated circuit components **222** on the printed circuit board assembly **204** when the printed circuit board assembly **204** is joined with the base plate **202**. These apertures **220** are

possible because of the greater strength and rigidity of the composite structure **200** in the present invention compared to a conventional base plate structure with the same thickness. This results in a structure **200** that is substantially rigid, providing the necessary support structure for the disc spin motor **214** and actuator assembly (not shown), while facilitating an overall drive thickness of no more than 3.3mm, thus meeting the size requirements for a Compact Flash card Type I form factor. The epoxy adhesive layer **210**, when cured, forms a substantially rigid layer between the base plate **202** and the printed circuit board assembly **204**. The epoxy is preferably a thermally conductive epoxy to ensure that sufficient heat dissipation for the component **222**, such as an integrated circuit, on the PCB **204** is maintained.

In the embodiment shown in FIG. **3**, the PCB assembly **204** is installed on the base plate **202** before the drive motor stator coils **214** are installed. Therefore a connector and associated connector pins are not required. The drive motor coil leads **216** can be directly soldered to a solder pad **217** on the PCB assembly **204**. In addition, because of the rigidity of the epoxy bonded PCB assembly **204** and the base plate **202** composite structure, there is no structural need for a PCB shield plate, as the base plate **202** itself replaces its structural function. This integrated composite structure **200** can withstand tremendous shock and impact events without damage.

Referring now to FIG. **4**, an alternative embodiment **300** of the present invention is shown. The structure **300** includes a base plate **302** similar in configuration to the base plate **202** shown in FIG. **3** except that in this embodiment, a PCB shield **306** is installed beneath a printed circuit board assembly **304** that is epoxy bonded to the base plate **302**. The assembly **304** includes a connector **305** that is also epoxy bonded to the base plate **302**. Again, as in the first embodiment, at its thinnest, the base plate **302** itself is between about 0.2mm and 0.3mm in thickness. The assembly **304** is sandwiched to the base plate **302** and the gap **308** between these two components is filled with epoxy adhesive **310**, which, when cured, bonds the base plate **302** to the PCB assembly **304**. The PCB shield **306** is spaced from the PCB assembly **304** by a gap **312** which is filled with epoxy adhesive **310** bonding the shield **306** to the PCB assembly **304**. Thus the three components, the base plate **302**, the PCB assembly **304**, and the PCB shield **306** together form the integrated, stiff, composite disc drive base structure **300**. This results in a structure **300** that is substantially rigid, providing the necessary support structure for the disc spin motor **214** and actuator assembly (not shown), while facilitating an overall drive thickness of no more than 3.3 mm, thus again meeting the requirements for a Compact Flash card Type I form

factor. The epoxy adhesive is preferably a thermally conductive epoxy to ensure that sufficient heat dissipation for the integrated circuit **316** on the PCB assembly **304** is maintained.

In either of the embodiments **200** or **300** described above, note that there are openings in the base plate **202** and **302** that permit the IC component **216** and **316** respectively to protrude through. An optional tape seal **318** may be installed over these openings as is shown in FIG. **4**. This seal may be utilized to preclude off-gassing from the epoxy into the sealed environment inside the assembled disc drive should this present a potential problem. In the integrated structure **300**, the additional layer of epoxy provides even further stiffness to the composite structure **300** compared to structure **200**.

An operational flow diagram of the manufacturing process **400** for manufacturing the integrated composite base plate structure **200** or **300** in accordance with the present invention is shown. This process **400** may be performed manually, semi-manually or automated. Process **400** begins in operation **402** in which the base plate **202** or **302** is fabricated and prepared, i.e. formed, de-burred and cleaned. Then, or concurrently, in operation **404**, the PCB and connector assembly **204** or **304** is assembled together into a single unit. Control then transfers to operation **406**.

In operation **406**, the PCB assembly **204** or **304** is installed on the base **202** or **302** respectively using epoxy adhesive. Control then transfers to query operation **408**. In query operation **408**, the assembled PCB/base plate is electrically tested. If the test is satisfactory, control transfers to operation **410**. If not, the assembled base plate and PCB assembly is discarded in operation **418**.

In operation **410**, the drive motor stator coils are installed and leads directly soldered to the PCB and connector assembly. Control then transfers to operation **412** where the drive motor hub and bearing are assembled to the base plate **202** or **302**. Control then passes to query operation 414.

In query operation **414**, the drive motor is functionally tested to ensure that the connections were properly made and that the control circuits on the PCB and connector assembly function properly. If the unit tests ok, i.e., query operation **414** answer is yes, control transfers to operation **416**. Otherwise, control transfers back to operation **410** for rework of the motor connections.

In operation **416**, the assembled composite integrated base plate and PCB structure **200** or **300** is packaged and transferred to a disc drive assembly facility. Optionally, the full assembly of the disc drive may take place at the same facility.

It will be clear that the present invention is well adapted to attain the ends and advantages mentioned as well as those inherent therein. While a presently preferred embodiment has been described for purposes of this disclosure, various changes and modifications may be made which are well within the scope of the present invention. Numerous other changes may be made which will readily suggest themselves to those skilled in the art and which are encompassed in the spirit of the invention disclosed and as defined in the appended claims.